

**Bulletin No. 2**

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# GRAFT MANGO GARDENS--HOW TO START AND MAINTAIN THEM.

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## INTRODUCTION.

The mango is a large evergreen tree easily grown in the tropics from the sea level up to an altitude of about 3,000 feet. The drier tracts of this presidency that receive less than 40 inches of rain in the year and where the rain ordinarily ceases sufficiently long before the blossoming season, appear to be well suited to the mango.

2. The mango is now extensively grown over large areas in the Vizagapatam, Gōdāvari and Kistna districts in the Circars as also in the Nellore, Chittoor and Salem districts. Waste lands which were once overgrown with shrub jungle are now thus fetching as much income as any other good land.

## VARIETIES.

3. Every seedling tree perhaps produces fruit differing from that of another, and may thus be considered a variety by itself. The variation in the offspring from the seeds of the same tree is due to the mango flower being naturally liable to cross fertilization. It is this factor that necessitates "grafting" to enable trees true to any selected type to be obtained. This method of propagation is believed to have been introduced into India by the Moghuls or the Portuguese.

4. The varieties now under cultivation are numerous, each tract having a number considered suitable to the locality and to the tastes or fancies of the people.

5. According to the quality of the fruit mangoes are usually classified into—

(a) Juicy mangoes, the pulp of which can be sucked, e.g., Rajumanu, and Chinnarasam. These have more or less fibre.

(b) Table mangoes in which the pulp is firm even when ripe and can be cut into pieces with a knife. This class is the most popular and largest grown. Jahangir, Himayuddin, Banganapalli, Andrews (Mulgoa), Black Andrews, Hamilton (Sannakulu) and Ganneru are some of the best of this class. The fruit of this class has little or no fibre.

(c) Intermediate varieties, in which the fruit can be eaten either way, e.g., Goa, Suvarnarekha, and Dilpasand.

(d) "Sweet" mangoes, which are fairly sweet and of a good flavour even when raw, e.g., Peta Thiyyamamidi and Nuzvid Thiyyamamidi.

(e) Pickle mangoes, which are very sour when raw, e.g., Baramasi (Asakapalli), Kolanka Goa, and Ooragayamamidi.

6. According to the time of ripening, they may be classified as very early (e.g., Rajumanu) early (e.g., Suvarnarekha) medium (e.g., Dilpasand) late (e.g., Banganapalli, Jahangir, Himayuddin, Black Andrews, and Hamilton) and very late (e.g., Mulgoa, Ganneru, Kolanka Goa, Bangalora and Nilam). To these classes may be added "out of season" varieties. Some of these, e.g., Nilam, bear a second time in November-December, while other varieties, e.g., Baramasi (all the year round, or, literally, twelve months' varieties) bear at irregular times thus prolonging the season all through the rest of the year.



7. Some of the well-known varieties have been named above, under one class or other. Of these Jahangir, Himayuddin, and Banganapalli are noted for their excellent flavour; Rajumanu, Suvarnarekha and Kolanka Goa for their steady bearing. Suvarnarekha is also noted for its very good keeping and transporting quality, ripening off to a fairly good taste and flavour even when plucked some time before reaching maturity. Bangalora, Nilam, Kolanka Goa and Banganapalli come next in order in this respect. Taking all points into consideration Suvarnarekha and Banganapalli have been chosen as the chief commercial varieties in the Vizagapatam and Gōdāvari districts, these accounting for about 60 per cent and 80 per cent respectively of the trade in the two districts.

8. Grafts of these and other varieties are available of nursery men at Allamanda in the Vizagapatam district, Kadium in the Gōdāvari district and at Salem.

### SOIL.

9. As observed above, the mango grows on almost any kind of soil, provided it is sufficiently deep and well drained. A red loam fairly deep with a substratum of loose gravel is ideal. Here, there is an uninterrupted development of the root system as well as free drainage essential for the length of life and bearing capacity. The peroxide of iron in this class of soils exerts a beneficial influence. It increases the vigour of the tree and sweetens the fruits.

10. In sandy soils as met with on the sea coast, the mango grows well, but the tree does not live long and the fruit is inferior. The addition of silt improves conditions favourable for its growth.

11. In clay soils, especially of an alluvial nature, the tree puts on heavy foliage and produces little fruit. Rich lands under cultivation with other crops are not recommended for the same reason.

12. In shallow soils, the root growth is checked as soon as a hard rock is reached. Unless the land falls steeply, water-logging and imperfect aeration in the rainy season ensue, but if the slope is steep there is insufficient moisture in dry weather. From either of these causes growth is arrested and the plantation is short-lived. The presence of a considerable number of small stones such as are found in the soils at the foot of the hills, does not affect growth, provided the soils are otherwise suitable.

### PROPAGATION.

13. As already indicated, propagation from seed does not ensure the offspring coming true to type. It is therefore desirable to plant "grafts". The most common method of grafting in vogue in the Circars is "inarching" which is a very simple process. A short account of this method is given below (See Plate I). In the fruiting season, the seeds (Fig. 1) are planted very thickly on heavily manured, well prepared soil. The seedlings (Fig. 2) when five to six months old are lifted, their tap roots are cut off (Fig. 3) and planted a span apart on fresh seed-beds. This encourages the development of surface roots and helps in potting which is usually done when 18 months old. To economise water, the potted plants, hereafter known as "stock," are buried flush with the ground in beds of convenient size, packed close, the intervening spaces being filled with sand or earth. So far as grafting is concerned the age of the stock does not matter much. Stocks three months to three years old have been

PLATE I.  
INARCHING.



(From the seed to the graft ready for sale.)

1. The seed.
2. A young seedling.
3. A five months old seedling (note tap root cut before potting).
4. A potted plant (pot is in two halves tied together).
5. A, the scion ; B, the stock.
6. The stock and scion brought together and tied up.
7. The graft ready for transport.
8. The split halves of a pot.
9. Bamboo basket for transport.



very successfully used, as far as union is concerned, but as the roots suffer from confinement in a pot, it is advisable to retain this cramped condition for as short a time as possible. When these stocks (Fig. 4) have sufficiently established themselves, the process of grafting begins. This consists in slicing off the bark and part of the wood for two to three inches along the stem of the stock and of the twig of the parent tree, known as "scion" (Fig. 5-A), bringing them together and securing them tight with a bandage of wax cloth or dry plantain sheaths (Fig. 6) to exclude air and water from the cut surfaces. In doing this, the cut edges of the cambium—a very thin active layer of tissue between the bark and wood—of the stock and scion are brought together and when these layers of tissues are retained for a time in close apposition, union of the two parts takes place and the wound heals by the natural process. For speedy success the stock and the twig operated upon should be of the same thickness. The union is complete in about three months, and the scion is severed from the tree in three or four stages at intervals of a week so that little harm is done to it. When complete severance has been effected, the graft (Fig. 7) is ready for planting. The grafts are then buried in the ground the pots touching one another to facilitate easy watering. They remain in this bed till they are sold and the scions that did not unite properly wither and gradually dry off.

14. In potting it is usual to use whole pots. This entails breakage and wastage in the transport of plants from place to place. To obviate this defect, it is recommended that pots in halves (Fig. 8) should be prepared and placed in juxtaposition while potting and tied with string as in Fig. 4. For transporting these pots can be removed and bamboo baskets of the same size (Fig. 9) inserted which reduces damage and renders these pots available for further use.

15. Experience has shown that the methods adopted hitherto in preparing grafts and planting them are capable of improvement. Gardeners are now convinced that the use of seed of all sorts indiscriminately for raising stocks results in the production of fruits of varying and uncertain quality, though the scions used are of the same quality. By such variation, uniformity in the maturity of fruit of even the same variety is lost. Some trees fruit off, while others just begin to flower or ripen. This raises the watching bill and reduces the chances of brisk demand for export. Growers therefore, now incline to the view that the selection of seed for raising stock is also necessary in addition to the selection of the scion.

16. Secondly, the cutting of the tap-root results ultimately in shortening the period of bearing of the grafts, as only surface roots are developed, the trees thereby having a less grip on the soil, and the area tapped for the abstraction of food ingredients becoming smaller. Unless heavy manuring is given every year, and careful attention paid, gardens deteriorate. Once deterioration sets in, renovation is not possible except at a prohibitive cost and renewing the plantation becomes more economical.

17. To obviate the above two defects, some experienced gardeners tried the following innovations. They selected seeds of varieties with desired qualities, planted them directly in pits in the future garden. To the seedlings thus raised as stocks they grafted the scions of potted grafts the qualities of the scions of which are definitely known, but the qualities of the stock of which, having been raised from seeds indiscriminately, were not known. This was believed to ensure definiteness

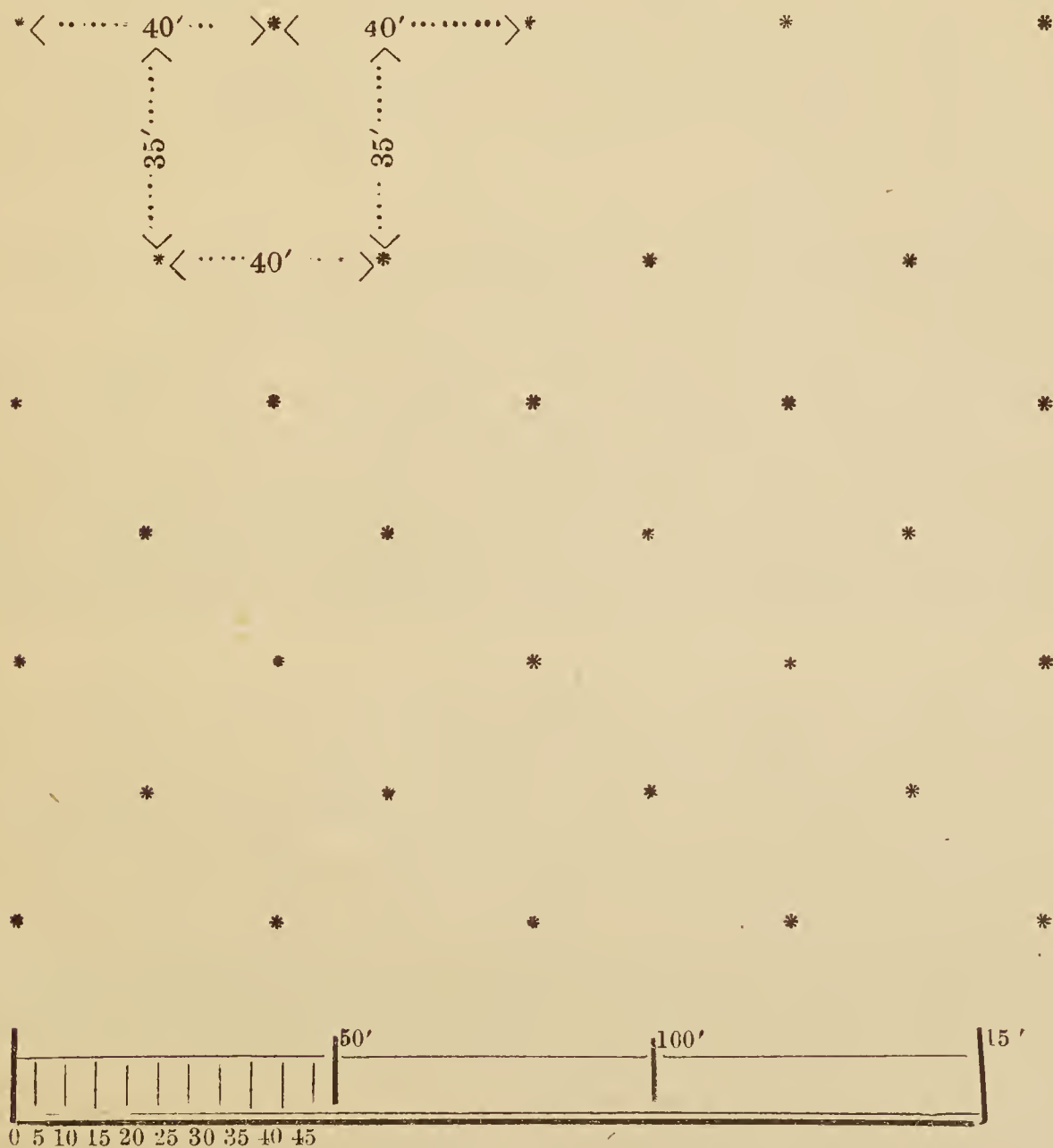
of characters in both the stock and the scion used and secure vigour, as the tap-root of the stock was not cut off. The life of the plantation was also thus expected to be lengthened.

18. Another device adopted to retain the tap-root is to put the seed in long narrow pots (about 18" deep) and graft on the seedlings thus raised without potting them from a ground nursery. This system, of course, involves grafting on fairly young plants.

19. There is a new school of thought however, which from experience gained of late by adopting the above methods, is, of opinion that the cutting of the tap-root is not so much responsible for the shortening of the life of the tree or for its stunted growth, as the operation of inarching, which is believed to weaken the system of the plant and prevent the tree from growing to the size of a seedling. This aspect however has to be more carefully studied before the above opinion can be finally accepted.

### PLANTING.

20. Each variety or a number of varieties that ripen at one time should be planted together in one block, to facilitate watering and gathering fruit. The number of plants to the acre varies with the soil. On rich soils where the trees spread well, 20 to 25 are planted while on gravelly soils where the growth is rather stunted, up to 50 trees to the acre are put in. The best average distance is 40 feet apart in rows 35 feet apart, the plants being arranged quincuncially whereby 32 go to the acre.



Scale 1" = 50 feet.



21. In good deep red loamy soils mango grafts have been found to make good progress when planted in pits just sufficient to receive the ball of earth in the pot in which it is growing. Usually, however, pits three feet wide are dug. The lower subsoil is kept separate from the top soil. The pits are left exposed to the sun for some weeks to effect complete drying. Some growers burn rubbish in them to shorten this period and to minimise the ravages of white-ant attack. When ready the pits, are, filled in with good surface soil to a sufficient depth. When available, dry canal or tank silt may be added. A mixture of silt and crushed bones is also recommended to be placed at the bottom. The earth is allowed to settle down for some time. If no rain falls the pits are thoroughly watered once and the graft planted. The pot is deftly broken, and broken pieces of pot, tile, or brick adhering removed and the plant with the ball of earth imbedding the root system is gently placed in the hole scooped out, flush with the ground. The soil in the pit is well pressed and a soaking watering given.

#### AFTER TREATMENT.

22. Subsequent waterings are given every evening for about ten days when alternate days become the rule. Bamboo or earthen tubes about three inches in diameter and a span in length may be inserted in the pit about nine inches from the plant so that the water is made available to the lower layers as well whereby economy in watering can be secured. When the graft has struck root, the bandage is removed, as otherwise the stem is constricted in growth. The portion of the stock above the point of union if it was not removed at the time of grafting, is also cut off. To protect the young grafts from strong winds propping is necessary till the plants grow to a sufficient size to protect themselves ; some strong, thin jungle wood posts or bamboos may be used as standards for propping.

23. Any shoots that may grow from the stem below the point of union should be removed as often as they appear, otherwise the grafts suffer and inferior fruits are produced, from such shoots.

24. Flowers that appear should be nipped off for four to five seasons to promote the growth of the tree. During the dry weather the land should be ploughed constantly and kept clear of weeds. For the first four to five years, until the plantation grows to a fair height and covers the ground, ordinary annual crops can be raised by liberal manuring and with the help of irrigation water when available. When this cannot be had, horse-gram and other pulses can be grown to arrest growth of weeds.

25. During this period well rotten farmyard manure and green-leaf may be applied to assist the growth of the tree. The latter may be applied during the rains as soon as sufficient leaf is available and the former about the middle of January when fresh growth commences.

#### THE CARE OF THE GARDEN IN THE BEARING STAGE.

26. Though the grafts begin to flower from the year of planting, regular bearing should not be allowed till the tree attains a good size, which it usually does in about five years. Thereafter the treatment that is given to a garden should aim at—

- (1) regular flowering every year,
- (2) good setting and retention of such a number of fruit as the tree can bear.



27. The flowering is generally good in years in which the rainfall during the north-east monsoon is light and ceases at an early date. The influence of these factors however differs somewhat with different varieties and soils, as also the bearing of the tree in the previous season. The chief way in which the cultivator can induce flowering of the tree in general is to ensure good drainage by digging drains and seeing that the soil of the garden dries off fairly well sufficiently long before the flowering season. This is especially necessary in stiff clays which are retentive and do not attain this stage early enough. In a season of heavy or late rainfall, leaving the land fallow after the rain helps flowering while interculturing retards it.

28. Other means sometimes adopted are deep trenching around individual trees (about 3 to 9 ft. from the trunk according to the size of the tree) and thus pruning off the roots which cross the trench, and application of about three or four pounds of common salt. These operations are all intended to reduce the vegetative growth of the tree. Making incisions in the bark of the tree also induces it to flower, by reducing the flow of the sap from the leaves downwards, and concentrating it in the flowering branches. It is a matter of common observation that for the same reason, trees bored by the mango beetle flower early and bear more profusely than other trees in the garden.

29. The setting of fruit depends upon the nature of the variety, weather conditions, and incidence of the mango hopper and mildew. The effects of the last two may to a certain extent be controlled by spraying (vide leaflet No. 3 of 1917 for details).

30. The retention of a reasonable number of fruit till the ripening stage depends upon the weather and soil conditions. Fruit fall in the early stages may occur if there is heavy rain after setting, but this occurs rarely. In the later stages fruit fall is the result of the soil not retaining sufficient moisture or of the exhaustion of trees. This can be prevented to a certain extent by interculturing the garden thoroughly and at the right time, to retain moisture. The effects of dust storms may to a certain extent be minimised by effective wind breaks all round the garden. Exhaustion of the trees generally occurs only in poor soils and may be prevented by ploughing in green manure crops, such as daincha, sunnhemp, cowpea or groundnut, and by the application of bone-meal with the green manure. The carting of tank or river silt to such gardens also keeps up the bearing capacity of the trees. The manuring of individual trees with silt or cattle manure mixed with 5 to 6 lb. of bone-meal or superphosphate may also be beneficial in some cases.

### YIELD.

31. Though the grafts are allowed to bear from the sixth year, they are in full bearing only from the eleventh year. The value of subsidiary crops grown during the first five years and of fruit obtained the next five years, can be set off against the cost of the plantation and its maintenance until the eleventh year, from which time it is reasonable to strike a balance sheet. Even with the best of care, the flowering, the setting of the fruit and its development are largely matters of uncertainty. Allowing for this 200 to 300 fruits worth about Rs. 6 may be estimated to be a fair yield. But in a big garden, taking into consideration trees of varying bearing capacities, an average income of Rs. 2½ per tree per year is a modest estimate. Instances are not

uncommon in which with regular root pruning, manuring, and watering, yields of fruit worth up to Rs. 25 or more per tree are obtained.

### COST OF CULTIVATION.

32. The cost of planting and maintaining a garden may be estimated as below :—

#### *First year.*

	RS.	A.	P.
Digging pits—32 at one anna each ... ..	2	0	0
Filling in with good earth, manuring and planting grafts at As. 4 per pit ... ..	8	0	0
Cost of 32 grafts delivered on the spot at As. 8 each ... ..	16	0	0
Watering, hoeing, watching, etc.—100 men at As. 6 each ... ..	37	8	0
Two ploughings at Rs. 1-6 per ploughing *	2	12	0
Pots, “kavidis,” etc., for watering ... ..	2	0	0
Total ...	68	4	0

#### *Second year.*

Watering, hoeing, watching, etc.—100 men at As. 6.	37	8	0
Manure (cattle manure and green leaf) and their application ... ..	5	0	0
Two ploughings *	2	12	0
Pots, “kavidis,” etc., for watering ... ..	2	0	0
Total ...	47	4	0

#### *Third, fourth and fifth years.*

Watering, hoeing, backward plants, watching, etc., per year—60 men at As. 6 each ... ..	22	8	0
Two ploughings*	2	12	0
Pots, “kavidis,” etc. ... ..	1	0	0
Total for each year ...	26	4	0
Total for the first five years ...	194	4	0

#### *From the sixth year onwards.*

Watching, digging, round plants, etc.—40 men at As. 6 ... ..	15	0	0
Four ploughings ... ..	5	8	0
Green manure seed to be sown in about 1/3 of the area every year ... ..	0	8	0
Total ...	21	0	0
Average yield from sixth to tenth year at Rs. 1½ per tree ... ..	48	0	0
Average yield from the eleventh year at Rs. 2½ per tree ... ..	80	0	0

\* NOTE.—Only ploughings at the beginning of the rains are taken into account ; horse-gram can be grown at the end of the rains.



## THE MANGO TRADE.

33. From the Circars as well as the Central districts, there is a considerable export trade in mangoes, besides a large local sale and consumption. From the Gōdāvari and Vizagapatam districts, large quantities are sent to Orissa, Bengal, United Provinces, Punjab and even to Sindh. Of late, there has been some export to Burma also. The total value of mangoes exported from the Vizagapatam district alone is estimated at four to eight lakhs of rupees every year according to the crop and prices.

34. The producers bring the fruit into the marketting places, where brokers arrange for its disposal to middlemen or merchants from the tracts referred to above, who dictate their own prices.

35. The fruit is packed with some paddy straw in bamboo baskets holding about 50 to 100 fruits according to their size. For export to Calcutta and places nearer, they are sent by road goods but to places beyond, they are booked by passenger trains or the parcel express. A considerable number of fruit is damaged in transit for which the producer is made to provide extra. Packing in dealwood cases as recommended in leaflet No. 2 of 1930 of the Department of Agriculture, Bombay, may be worth a trial. The railway authorities have also to be induced to provide well ventilated waggons and for their quick transport. The interference of brokers and middlemen who deprive the producers of more than a fair share of their dues may also be eliminated at least partly, if the latter organize themselves into co-operative export societies for each centre of trade which in turn may all affiliate themselves to a central organization to ensure concerted action in all matters and prevent competition among themselves.

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## APPENDIX.

### NOTES ON SEVEN PRINCIPAL VARIETIES OF MANGO.

(See Plates II—VIII)

1. *Rajumanu*.—A small sized very early juicy variety of local selection ripening yellow; sweet fairly thin juice of good taste and flavour; small seed with very little fibre; fruit keeps moderately well; tree not quite hardy but bearing generally steady and profuse; fetches a fair price for the size on account of its earliness; largely consumed locally but also exported to some extent.

2. *Goa*.—Locally known as *Chinna Goa*; one of the varieties originally introduced by the Portuguese; a small sized early variety ripening off yellow with a red colour on one side; suitable for the table as well as for sucking; of a fine subacid sweet taste when fully ripe; fibreless small seed; fruit keeps well; tree hardy and vigorous; but bearing uncertain and rather poor; once largely grown, but of late being given up.

3. *Suvarnarekha*.—Sometimes called *Chinnasuvarnarekha* to contrast it with *Peddasuvarnarekha* from which it is said to have been evolved; a small fruited early variety ripening of yellow with a bright red colour on one side, which is one of its chief attractions. a fine sweet taste and good flavour when ripe; suitable for the table as well as for sucking; ripens off to a fairly good subacid taste even when plucked somewhat immature; medium sized seed with very little fibre; stands transport admirably well on account of its thick skin; the most largely exported variety from the

Vizagapatam district; a rather slow growing tree of moderate vigour; but bears regularly and fairly profusely; not much affected by weather conditions and the mango hopper pest.

4. *Hamilton*.—Locally known as *Sannakulu*; a late table variety of medium size, the fruit being very short as compared with its breadth; ripens off yellow with a firm flesh; sweet and of a good flavour of its own; fruit keeps well and stands transport; fibreless small seed; tree hardy but generally poor in bearing; badly affected by weather conditions and hopper pest; not largely grown of late.

5. *Kolanka Goa*.—Also a late table variety of local selection; medium sized fruit ripening yellow; of rather poor flavour; fibreless small seed; fruit keeps well and stands transport; a hardy tree bearing steadily and profusely; not affected much by weather conditions and hopper; fairly large export trade.

6. *Banganapalli*.—A well known late table variety of medium size; fruit rather broad and flat, ripening of bright yellow (fetches a high price); pulp firm and of an excellent taste and flavour; fruit keeps and stands transport fairly well; the chief commercial variety in the Gōdāvari district; tree hardy, and quick growing; bearing moderate but fairly steady.

7. *Bangalora*.—Locally known as “Collector”; a very late variety with a medium sized long and peculiarly shaped fruit; ripens off yellow, often with a red tinge on one side; pulp very firm and skin thick; fruit keeps very long and stands transport well; fruit can be retained on the tree itself and thus rendered available for a long time after the season; though poor in flavour, fetches a good price on account of its availability out of season; fairly largely cultivated and exported.

NOTES.—1. Fruits weighing below 6 oz. are considered very small; 6 to 12 oz. small; 12 to 24 oz. medium; 24 to 42 oz. large; and above 42 oz. very large.

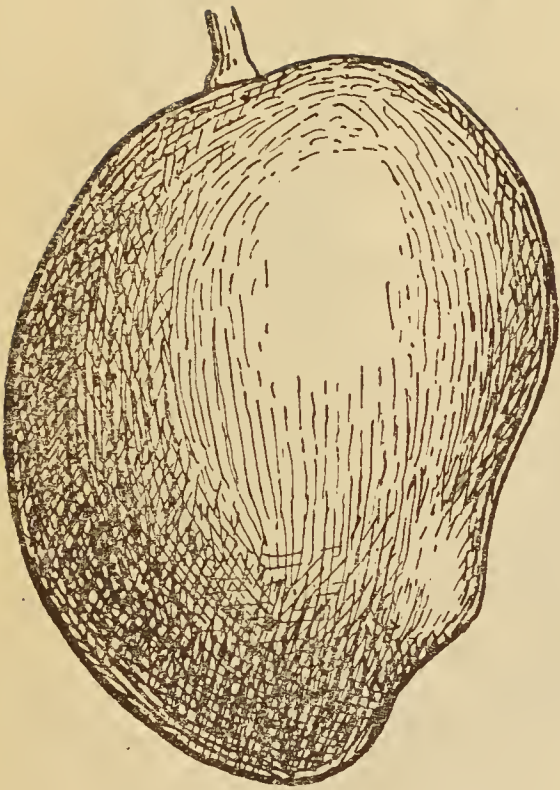
2. The seed is considered very small when its weight is not more than 5 per cent of the weight of the fruit; small when it is between 5 and 10 per cent; medium when it is between 10 per cent and 15 per cent; large when it is between 15 per cent and 20 per cent and very large when it is over 20 per cent.

3. The fruit is considered to be very short when its height is less than that of its breadth; short when it is less than 25 per cent longer than the breadth; medium when it is between 25 to 50 per cent longer than its breadth; long when it is 50 per cent to 100 per cent longer than its breadth; and very long when the height exceeds double the breadth.

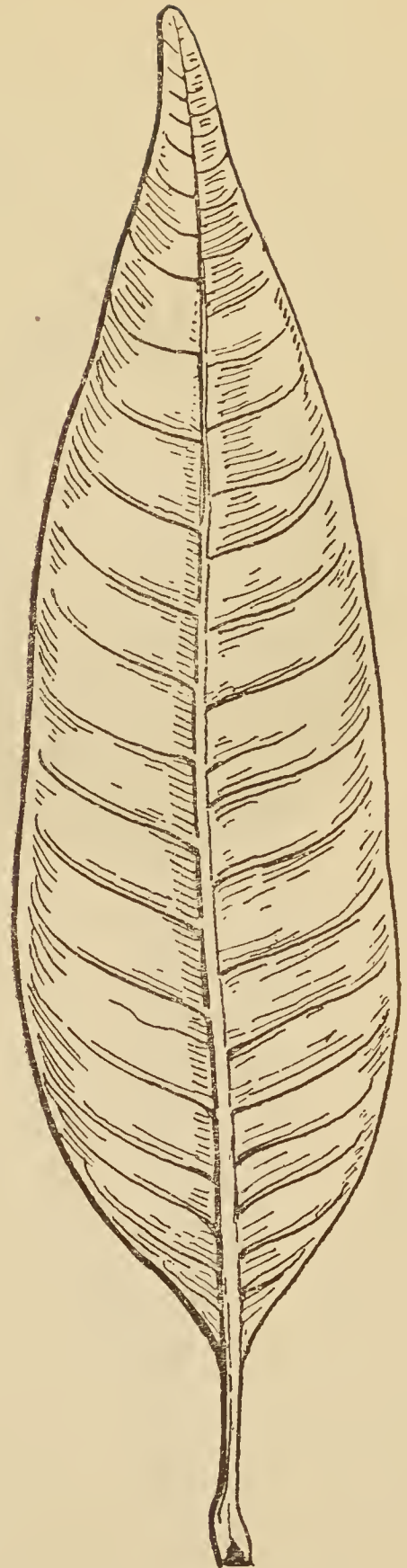
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PLATE II.  
RAJUMANU.

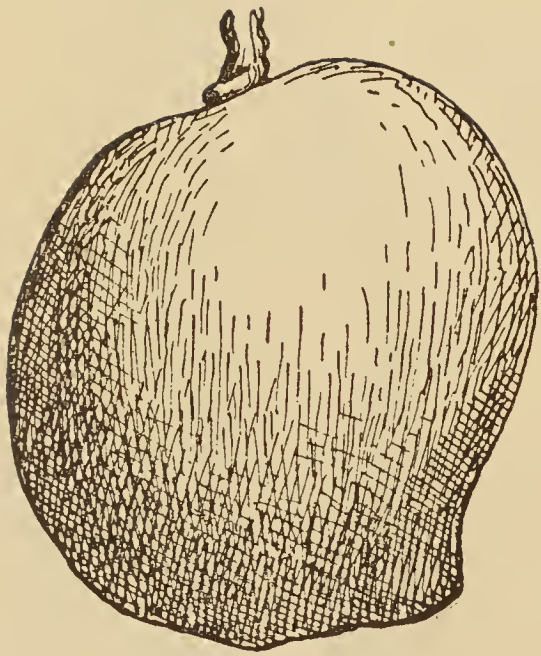


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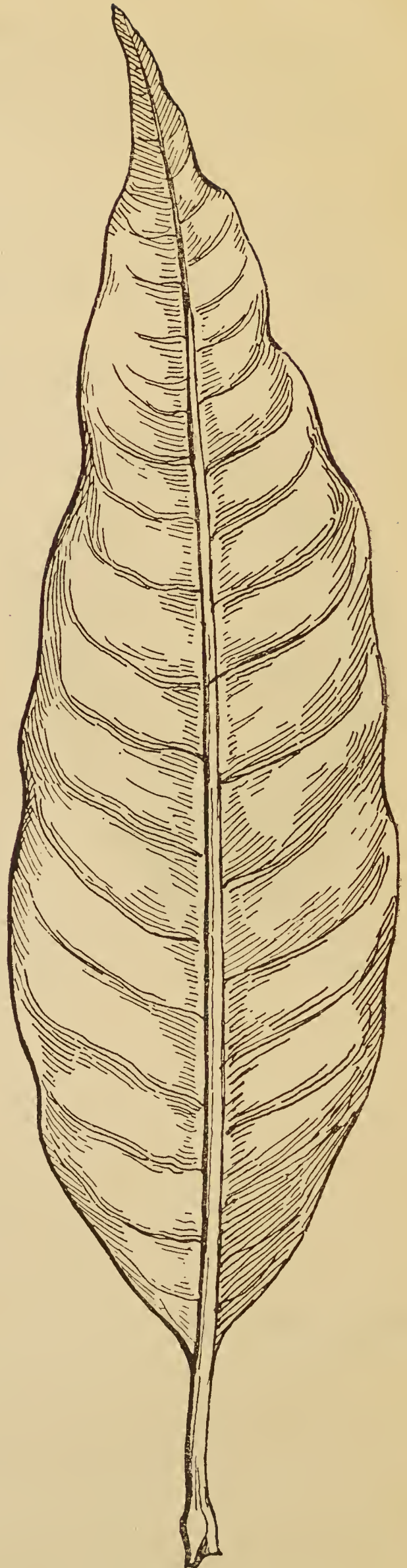


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PLATE III.  
CHINNA GOA.



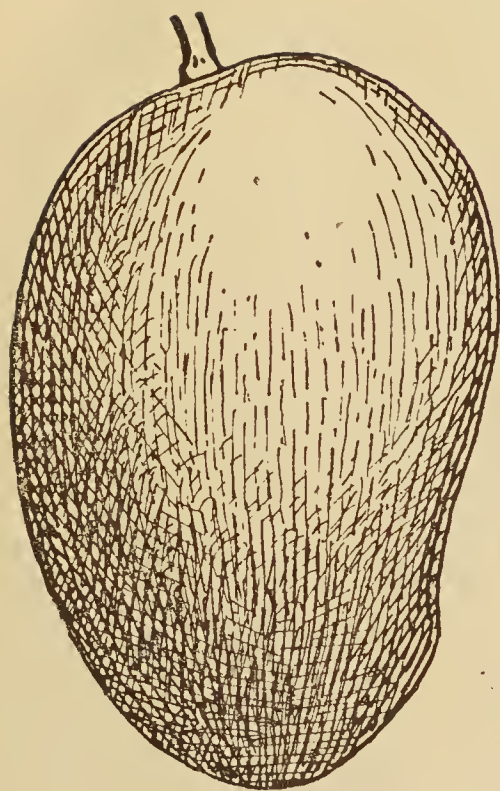
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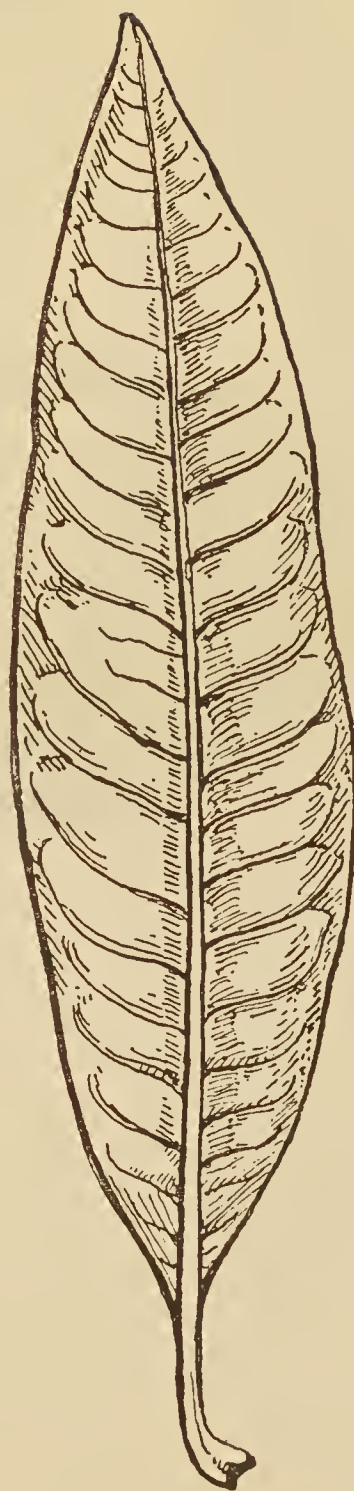
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**PLATE IV.**  
**CHINNA SUVARNAREKHA.**

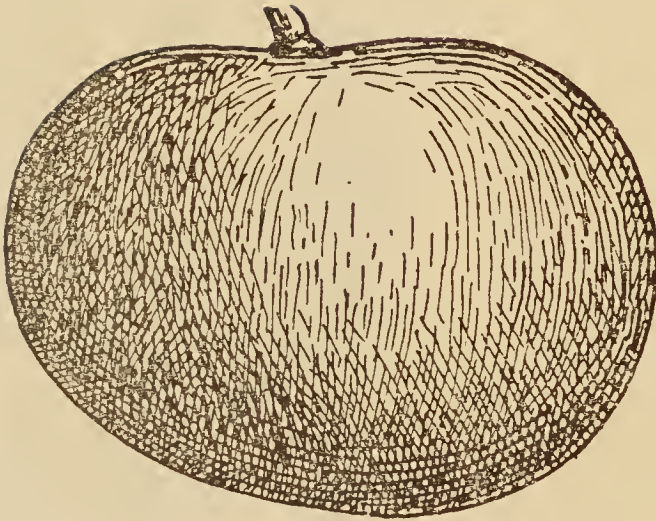


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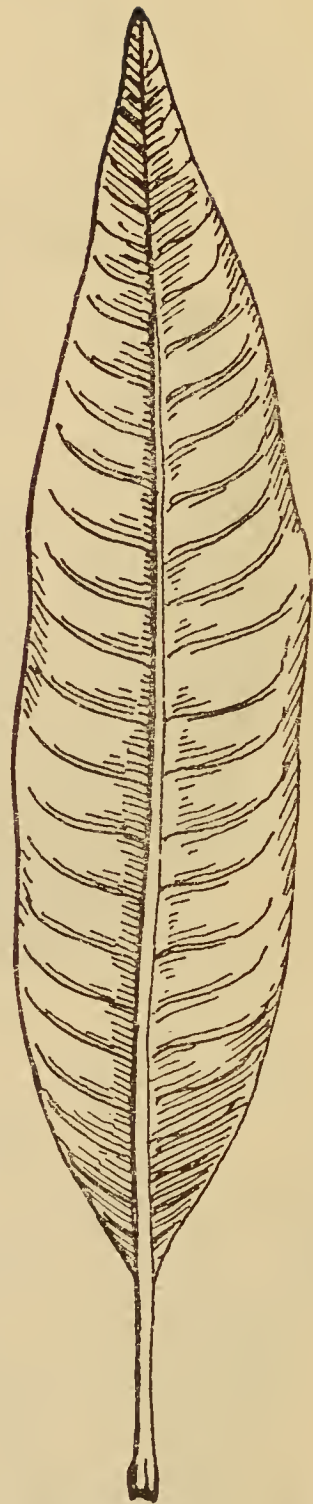


(Half the natural size.)

**PLATE V.**  
**HAMILTON OR SANNAKULU.**



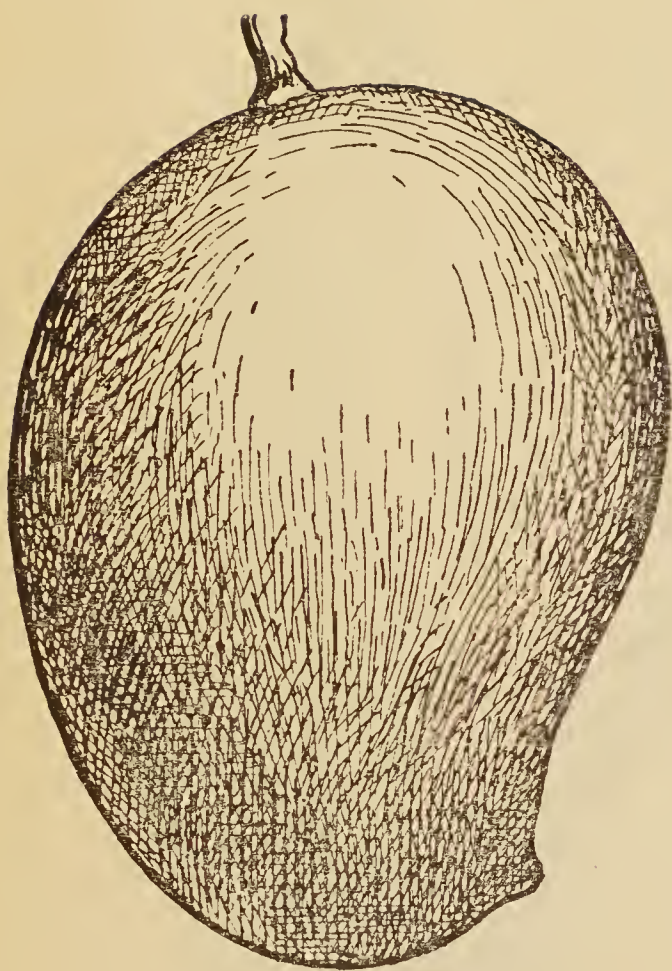
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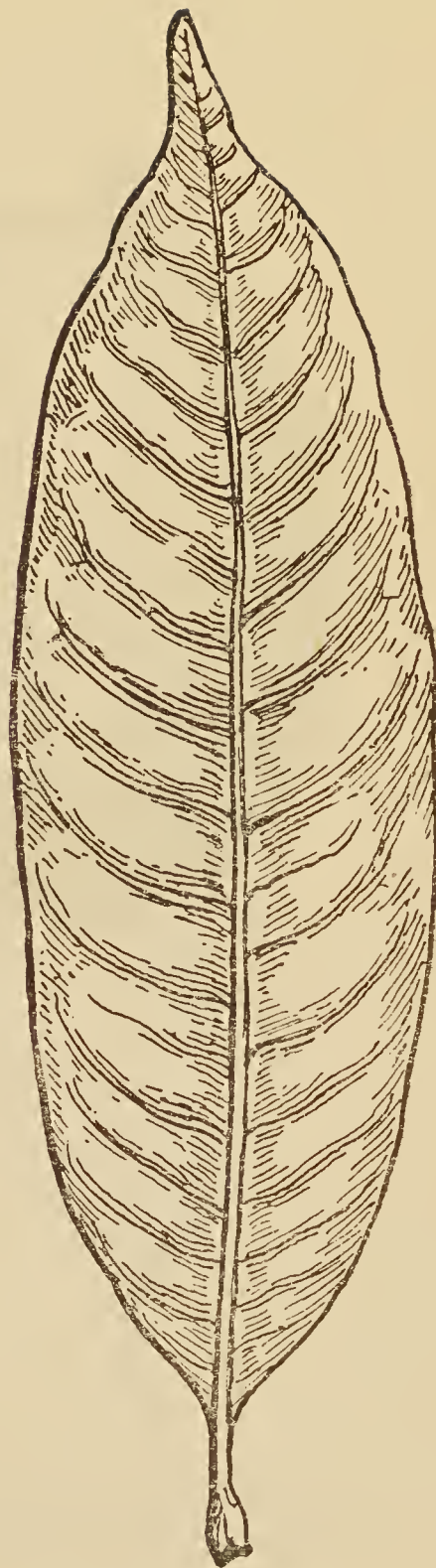
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**PLATE VI.**  
KOLANKA GOA.

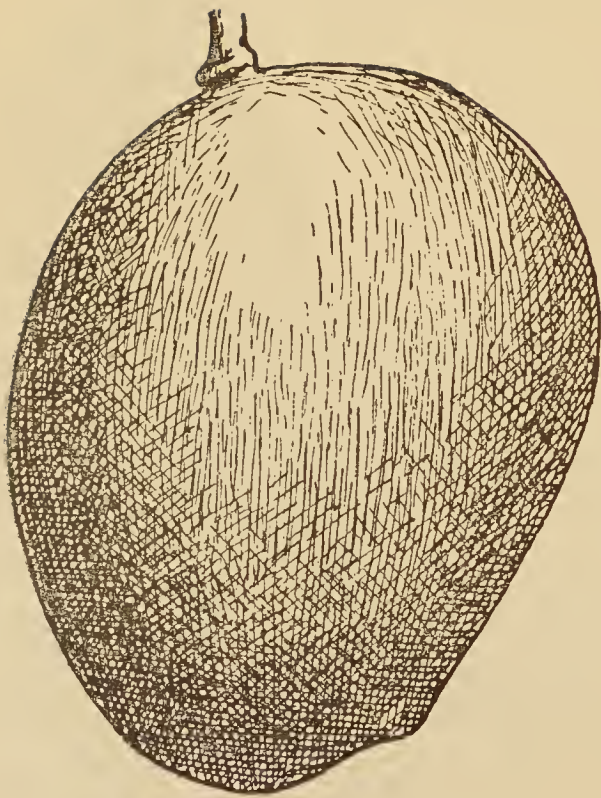


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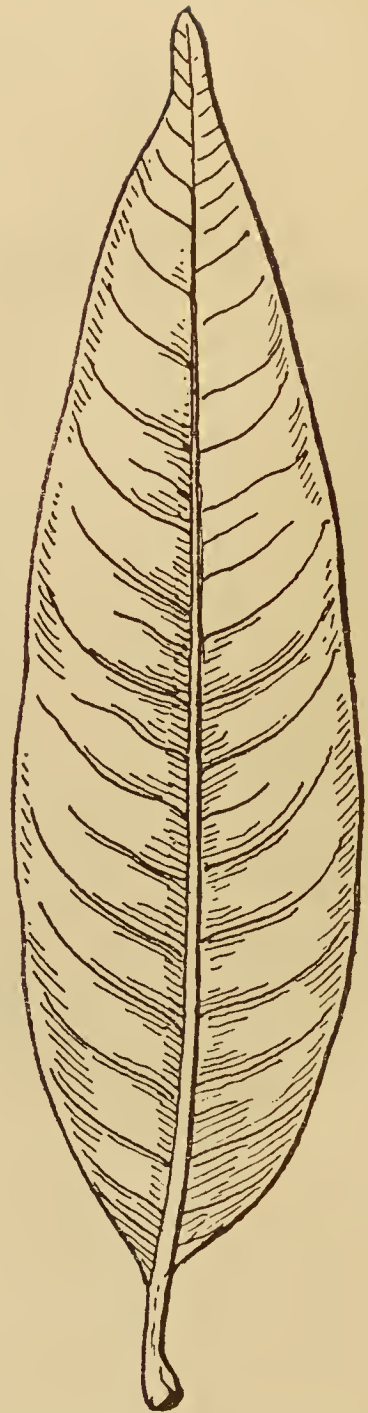


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**PLATE VII.**  
**BANGANAPALLI.**

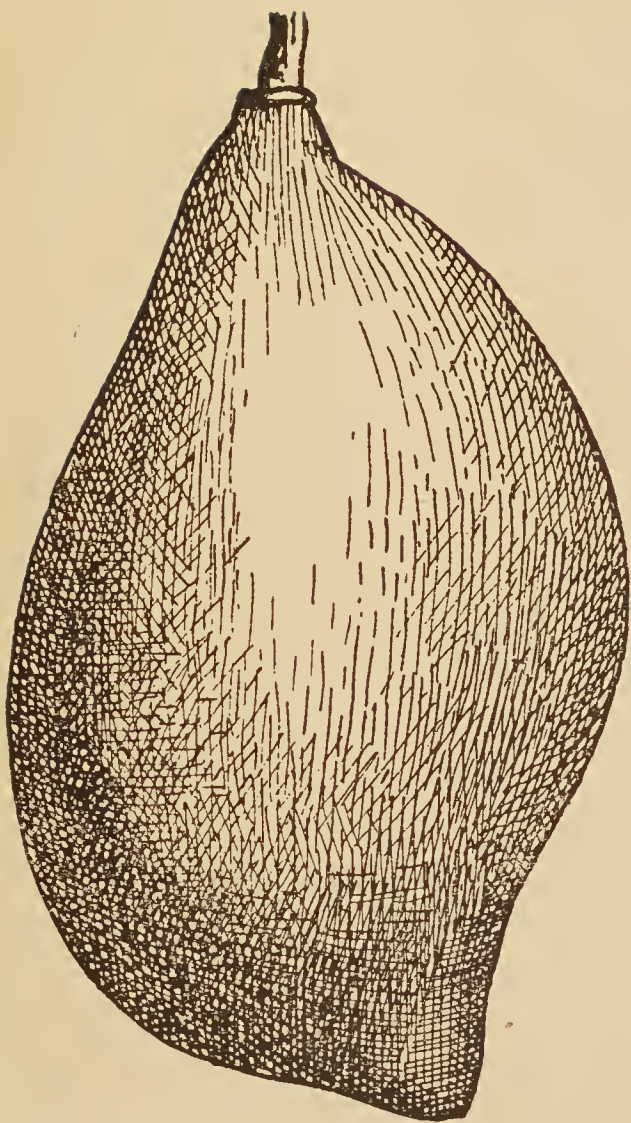


(Two fifths the natural size.)

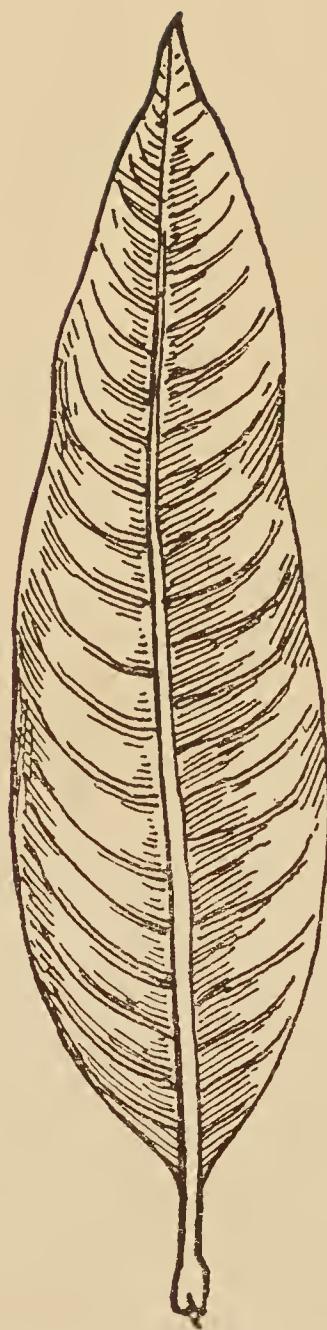


(Half the natural size.)



**PLATE VIII.**BANGALORA *or* COLLECTOR.

(Half the natural size.)



(Half the natural size.)







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